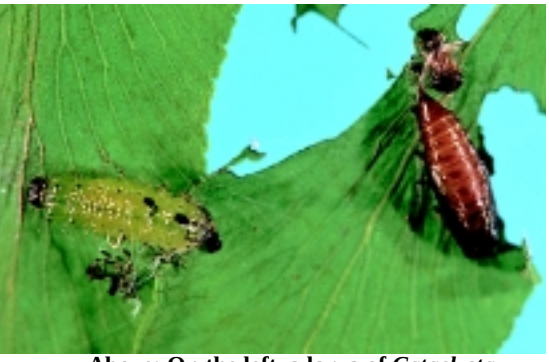
Global Search for Climbing Fern's Foes

"It's like a giant, green, undulating blanket that covers the landscape. It's a real monster."

That's how ARS entomologist Robert W. Pemberton describes Old World climbing fern—a fast-growing, exotic weed that threatens to take over Everglades wetlands and other native ecosystems in central and south Florida. Windborne spores of this weedy invader could spread it to Texas or southern Louisiana, as well.

To help stop the fern, Pemberton, at Fort Lauderdale, Florida, along with ARS entomologist John A. Goolsby and coresearchers at Indooroopilly, Australia, are searching the world for insects and other organisms that are powerful natural enemies of climbing fern. The scientists are likely the first to seek biological controls for this invasive plant.

Below: In the Florida Everglades, Old World climbing fern engulfs a tree island. Photo by Peggy Greb. (K8960-1)



Above: On the left, a larva of *Cataclysta camptozonale* feeds on climbing fern leaves. On the right, a brown sacklike pupa and a skin from a larva. (K8965-2)

Pemberton is with the ARS Invasive Plant Research Laboratory. Goolsby is director of the ARS Australian Biological Control Laboratory, near Brisbane.

With further testing, the biological control agents these researchers are investigating might be approved for use in Florida to forestall the formidable fern.

Massive Walls of Green

Known to researchers as *Lygodium microphyllum*, climbing fern is named for its ability to clamber up the stems and trunks of other plants. It often reaches up and over the tops of trees, forming high, massive walls of light-green vegetation that can completely cover the host plant.

What's more, the fern can form tough, spongy mats on the ground. Sometimes as much as 4 feet thick, the mats can easily smother native plants, such as Florida's rare curly-grass fern.

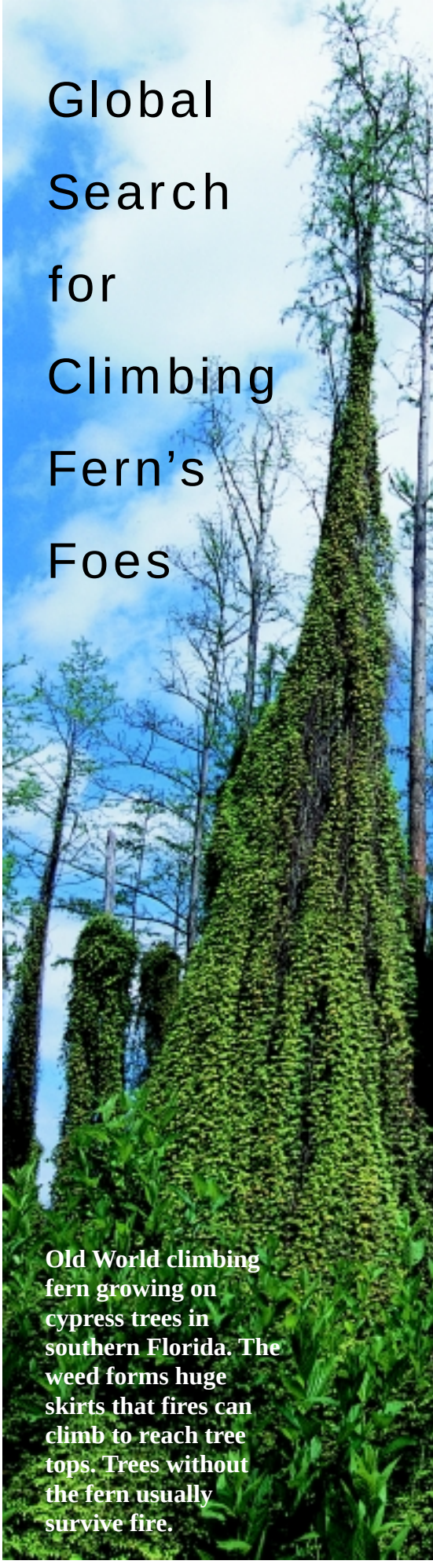
In addition, climbing fern can worsen the fire hazard in whatever ecosystem it invades. Fires that might otherwise remain in an understory, scarring trunks but not killing the trees, for example, may use the fern as a ladder. Flames that race up into the canopy may deal a death blow to the trees. Also, hot air rising from the blaze can carry burning pieces of fern to new areas, spreading the fire.

Even cold weather won't necessarily quash the weed. "Frost can kill the aboveground parts of the plant," says Pemberton, "but it can grow back if the roots aren't killed. And if the roots are growing in water, as is common, they have additional protection from frost."

Spraying with herbicides is costly. Besides, the fern "can regrow after spraying," Pemberton notes. "Spraying can also kill native plants. That's why biological control is probably the best long-term solution."

Explosive Growth Documented

It's no wonder that this noxious plant was recently listed as one of Florida's



Old World climbing fern growing on cypress trees in southern Florida. The weed forms huge skirts that fires can climb to reach tree tops. Trees without the fern usually survive fire.

PEGGY GREB (K8957-1)

most serious invasive weeds. Climbing fern probably first started showing up outside of ornamental gardens in that state in the 1960s. It has spread at an alarming rate, from about 39,000 acres in 1997 to more than 100,000 acres in 1999, according to estimates from aerial surveys taken every other year by the South Florida Water Management District.

In a quest to find biological controls, Pemberton last year spent 6 weeks slogging through hot, humid, fern-filled swamps on the coast of west Africa, searching in Cameroon, Benin, and Ghana for candidate agents. Entomologist Ted D. Center, leader of the Invasive Plant Research Laboratory, explored for biological control organisms in South Africa.

PEGGY GREB (K8956-4)

Entomologist Robert Pemberton examines a spore-bearing leaflet of the Old World climbing fern.

Both met with little success. The few specimens that Center found were lost when he was carjacked.

Pemberton found a lot of climbing fern, but very little that affected it. "We don't understand why there are so few natural enemies where we have looked in Africa," he says. "Africa is part of the weed's native range. But relatively few other *Lygodium* species grow there, compared to Australia or Southeast Asia—where climbing fern is also native—so maybe that's a factor."

"Also," adds Center, "abundances of the native enemies may be strongly seasonal. So, unless you're there at the right time of the year, you don't see the biological control agents. This is the advantage of having a foreign lab—like the Indooroopilly unit—in the native range of the target weed species."

New Expeditions Planned

In August and September, Pemberton will look for candidate insects that attack *Lygodium* ferns in Brazil and Argentina. "If these tropical insects attack only *Lygodium* species, they'll be safe to use in the United States," he says.

"If we use South American—that is, New World—enemies that Old World climbing fern hasn't experienced, these biological control agents might be even more damaging than enemies from the fern's homelands."

"This is a long shot and involves deliberate use of insects not from the target weed, but instead from related species," Center points out. "However, we think it's worth a try."

Meanwhile, the Australian team of ARS' John Goolsby, along with Tony Wright of the Commonwealth Scientific and Industrial Research Organization, have explored large parts of climbing fern's native range in Australia and Southeast Asia. In all, they've looked for biological control agents in Thailand, Malaysia, Singapore, Indonesia, and northern and eastern Australia.

"In its native ecosystems," Goolsby says, "climbing fern is a well-behaved member of the plant community. It's hard to believe that this same plant is so invasive in Florida until you've actually seen it there."

Small Moth, Big Hopes

At the Indooroopilly laboratory, Goolsby and colleagues have extensively tested one of their most promising finds—a small moth called *Cataclysta camptozonale*. "We collected this moth on climbing fern in subtropical

Queensland, in eastern Australia," says Goolsby.

The moth—bright white with a few black and brown spots and stripes on its wings—measures only about a half inch from wingtip to wingtip. It lays small, yellow eggs on fern fronds. The slender, light-green larvae that hatch from the eggs "cause considerable damage when they munch on fern leaves," Goolsby says.

"Our tests with 15 fern species," he reports, "showed that the moth lays its eggs and feeds on climbing fern, as well as a related pest called *L. japonicum*, and a native North American *Lygodium* species called *L. palmatum*. We think the moth won't pose a threat to the native fern, however, because the eastern United States—where the fern occurs—is probably too cold for the moth to survive. To make sure, however, we're conducting new tests to find out what temperatures the moth can tolerate."

More Moth Tests Ahead

In the meantime, the Indooroopilly researchers have shipped more than 250 *C. camptozonale* to ARS entomologist Gary R. Buckingham in Gainesville, Florida, for exhaustive testing. Buckingham and Christine A. Bennett of the University of Florida will pit the moth against a battery of as many as 84 plant species, including many rare Florida ferns. If their tests and the remaining experiments at Indooroopilly show the moth poses no threat to native plants or commercial crops, the Florida team will seek state and federal approval for outdoor release of this insect.

The Indooroopilly team is also conducting rigorous tests of two moths that are relatives of *C. camptozonale.* One is a dark brown *Neomusotima* moth that they found feeding on climbing fern during their expeditions to remote regions of northern Australia, as well as in Malaysia and Thailand. The moth's wings are edged with white and

PEGGY GREB (K8959-1)

Underside of spore-bearing leaflets of Old World climbing fern. Some leaflets produce spores; others don't. Spores can be carried by the wind to start new infestations.

decorated with small, white, boomerang-shaped markings.

Tony Wright found the second moth, a light-tan *Musotima* species, in Malaysia and Thailand. This insect has dark-brown flecks and ribbons of brown on its wings, and several white splotches on its small, upper wings, called forewings.

An expedition by Pemberton to Hong Kong, Taiwan, and Japan in 1997 paved the way for the moth research. He was likely the first researcher in the world to report the damage that musotine moths can inflict on the plant.

Microscopic Mite Might Assist

Goolsby's team is also studying a microscopic, tan-colored mite. Tony Wright came across it on fern fronds in Indonesia, Malaysia, and Thailand. Goolsby has found the mite on climbing fern throughout Australia.

A member of the *Floracarus* genus, this eight-legged creature eats the fern's leaf edges and growing tips. That feeding causes the edges and tips to curl up, forming a safe, snug shelter where the mites can mate, lay eggs, and hide from enemies.

Says Goolsby, "We're determining whether these mite attacks weaken the plant, making it more susceptible to disease."

Goolsby and co-workers have planned new expeditions to find even more biological control candidates. In the works: ventures to Papua New Guinea, Irian Jaya, Palau, Hong Kong and other parts of southern China, and return visits to remote, crocodile-infested swamps of northern Australia.

"Our group and the Florida team," Goolsby says, "are spreading out all over the globe to find the best biological controls to use against climbing fern."—By **Marcia Wood,** ARS.

This research is part of Crop Protection and Quarantine, an ARS National Program (#304) described on the World Wide Web at http://www.nps.ars.usda.gov/programs/cppvs.htm.

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Entomologist John Goolsby examines Old World climbing fern in its native habitat in Queensland, Australia.